the honeycombed ice remains intact and becomes nothing more than a collection of vertical ice needles ready to topple over at the slightest touch. Outwardly this sheet of instability appears firm and compact. During the period of rotting the temperature of maximum density is slowly advancing upwards towards the ice sheet. Below the surface of maximum density convection of heat brings more and more warm water up from the bottom. There must be then a definite surface in the water at 4° C., below which the temperature is kept fairly uniform by convection and above which there is no movement in the water to disturb the existing temperature gradient up to the ice sheet. As soon as the 4° surface reaches the under side of the already honeycombed ice the change of temperature and movement of water must be fairly sudden, causing a rapid collapse of the whole structure. This no doubt accounts for the characteristic rattling noise when the phenomenon takes place. The ice needles soon melt in the warm water, which gives rise to the general belief that the ice sinks.

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April 16, 1910

PLANKTON

THE article of Professor Chas. E. Woodruff in SCIENCE of April 22 recalled to me observations I had made of phosphorescence of the sea. In connection with astronomic work I have sailed many seas, and have circumnavigated the globe in completing its astronomical girdle in longitude.

In the waters along southeastern Alaska, an area of fog, rain and little sunshine, I had observed most exquisite phosphorescence of the sea. When being rowed from the government steamer ashore, every dip of the oars showed them surrounded by that delicate bluish light of phosphorescence. When I walked over the beach of the receded tide every footprint was a blaze of this same light.

Some years subsequently when I started on my work round the world I looked forward with pleasure to beholding the grand phosphorescence of the tropics, under the belief that in the warmer waters and bright sunshine, the plankton—the cause of the phosphorescence—would be more densely distributed. In this however I was sadly disappointed.

In none of the tropical seas did I see any phosphorescence that could at all compare with what I described above. In vain have I stood at night at the bow or side of the steamer on a smooth sea watching for a fine display of phosphorescence. Now and then the comb of the small wave as the vessel parted the waters showed a fringe of the bluish light, and nothing more.

Arrhenius in his "Lehrbuch der Kosmischen Physik," p. 376, says that the phosphorescence of the sea "is most beautifully developed in the tropics," which is not my experience. Major Woodruff's explanation and application to the tropics of the destructive and lethal effect of light on the plankton agrees very well with my observations on the phosphorescence of the sea in different parts of the world.

OTTO KLOTZ

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April 28, 1910

ATHANASIUS KIRCHER AND THE GERM THEORY OF DISEASE

IN reference to Dr. Riley's note in SCIENCE for April 29, I am glad to make a prompt *amende honorable* for a hasty error of commission in regard to the magnifying power of Leeuwenhoek's microscopes, but it is difficult to see how any injustice has been done to Athanasius Kircher thereby, since the quality of his magnifying glass seems principally a matter of conjecture. If we accept Osler's adjustment of the matter of priority in the bacterial theory of infectious diseases, then the medical fame of the remarkable priest who was also a mathematician, physicist, optician, pathologist, Orientalist, musician and virtuoso, rests rather upon his seven experiments upon the nature of putrefaction[1] than upon his

[1] "Kircher Scrutinium," Romæ, 1658, caput VII., pp. 42–49.

central thesis: *Quod ex putredine perpetuo corpora quædam insensibilia in circumsita corpora exspirentur, quæ effluvia pestis seminaria dicuntur*,[2] the terminology of which immediately suggests the excerpts I have given from Fracastorius.

Kircher's "Scrutinium pestis," one of the acknowledged landmarks in medical progress, was published in Rome in 1658, at least seventeen years before Leeuwenhoek's discovery of the infusoria (1675) and twenty-five years before his Royal Society paper on the microorganisms found on the teeth (September 17, 1683); so that making every allowance for the skill and proficiency of seventeenth century opticians in grinding and polishing lenses, the question whether Kircher's lenses were better or worse than Leeuwenhoek's is one of those "improbable problems" that each one can settle according to his personal preferences. No one will deny that Kircher saw some minute organisms under his glass, but my quotation from Puschmann's "Handbuch" to the effect that this glass was "only a 32-power at best" was, I think, taken from a most authoritative source, Loeffler's "Vorlesungen," and certainly between this statement and Kircher's own romantic assertion that his lenses magnified a thousandfold, there is opportunity for extreme latitude of opinion. If Kircher's microscope still exists, say in the Vatican collection or any other collection left by him, the point might perhaps be settled by having the lenses examined.

Leeuwenhoek's paper of 1683[3] contains what appear to be accurate figurations of chains of bacilli as well as of individual spirilli and bacilli, and I am informed by a competent bacteriologist that it would be perfectly possible to see such chains and clumps with an occasional motile specimen through a glass of the power specified by Dr. Riley. All honor then to the father of microscopy, who, if he saw bacteria without staining methods, showed himself a genuine laboratory worker, by also drawing them. But neither the notations of Leeuwenhoek, nor the labors of Müller, Ehrenberg, Cohn and Nägeli, can compare with the gigantic strides made by Pasteur, who, as Virchow once passionately declared,[4] was the first to handle the bacterial theory of infection in "the grand style" (*im grossen Styl*), and thence to attempt a working theory of immunity and a practicable enlargement of Jenner's scheme of preventive inoculation. It is this that gives Pasteur his fixed and unassailable position as the true founder of bacteriology—at least so far as the history of medical science is concerned.

In reference to Dr. Henry Skinner's note on the mosquito theory of yellow fever,[5] I have been reminded by Professor Osler that there are authorities recently cited by Boyce[6] "that quite put Finley in the shade." Of these the claims of Dr. J. C. Nott (1848) have not been disputed, while a paper by Louis-Daniel-Beauperthuy, published in the "Gaceta Oficial de Cumana" (1853) is probably the best early contribution extant on the mosquito theory, containing a remarkably clear perception of the hæmolysis produced by toxins and venoms, and a clever note on the characteristic striped legs of the yellow fever mosquito (*Stegomyia calopus*).[7]

That the deductive theorists of one generation should rest upon the shoulders of their predecessors seems natural if we consider that only inductive demonstrations, like those of Harvey, Pasteur, Lister, Reed and Carroll, constitute real tangible proofs. The kinetic theory

[2] *Ibid.*, 29.

[3] A. Leeuwenhock, "Ontledingen en Ontdekkingen," Leiden, 1696, 1. Stuk, pp. 12–15; the cut on p. 13 is reproduced by Loeffler and in Jordan's "General Bacteriology," Philadelphia, 1909, p. 18.

[4] "Wenn man jetzt auch darüber streitet, wer die ersten waren, welche diesen oder jenen Gedanken entwickelt haben—das kahn Niemand im Abrede stellen: Pasteur ist es gewesen, der im grossen Styl die Frage von der Uebertragung der Krankheiten durch bestimmte infectiöse Körper in die Hand genommen hat, und der darauf hin die Immunitätslehre zu begründen gesucht hat." Rudolf Virchow, *Verhandl. d. Berlin. med. Gesellsch.*, 1895, XXVI., 161.

[5] Science, April 22.

[6] Sir R. W. Boyce, "Mosquitoe or Man?" London, 1909, 23–28.

[7] *Ibid.*, 24–25.

of gases, one of the greatest modern physicists informs us, is "lost in antiquity." The atomic theory of matter is accurately stated in the "De rerum natura" of Lucretius, who got it from its Greek author Democritus; and Lord Kelvin, in his ingenious essay "Æpinus atomized," has indicated that the essential features of the electronic theory of matter had already been stated over a hundred years before, by the Rostock physicist Franz Hoch (1759). Who can doubt that the Greek scientists owed much to the learned Orientals and Egyptians who preceded them? We may take comfort then in the shrewd observation of the author of "Hudibras" that the speculative theorist is often several generations behindhand:

> "For Anaxagoras long agone,
> Saw hills, as well as you, in the moon;
> And held the sun was but a piece
> Of red hot iron, as big as Greece;
> Believ'd the heavens were made of stone,
> Because the sun had voided one;
> And, rather than he would recant
> The opinion, suffered banishment."

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A COMMENT ON ASPHYXIA

SOME surprising material is contained in Dr. John Auer's reply[1] to a note on the "Effect of Asphyxia on the Pupil," by A. H. Ryan, F. V. Guthrie and myself.[2] As he does not present any evidence against, nor even deny the accuracy of our observations on, the phenomenon to which we recalled attention by the statement that as a rule a very marked constriction of the pupils occurs in an early stage of asphyxia, no reply is necessary.

But since he attempts to account for our statement by saying that had we pushed our experiments further we "would have found the marked dilatation of the pupil which occurs in mammals during the second and third stages of asphyxia," as the senior author of the note I feel it incumbent upon me to make certain statements in order that those not thoroughly conversant with the subject may not receive erroneous impressions regarding the phenomena of asphyxia on the pupil.

It would seem that the classical phenomena of asphyxia are too well known to require mention, but in view of the above, I will here give an elementary statement of them taken from Starling,[3] to whom we referred in our communication:

> The phenomena of asphyxia may be divided into three stages:
>
> 1. In the first stage, that of hyperpnœa, the respiratory movements are increased in amplitude and in rhythm. This increase affects at first both inspiratory and expiratory muscles. Gradually the force of the expiratory movements become increased out of all proportion to the inspiratory, and the first stage merges into:
>
> 2. The second, which consists of expiratory convulsions, in which almost every muscle of the body may be involved. Just at the end of the first stage consciousness is lost, and almost immediately after the loss of consciousness we may observe a number of phenomena extending to almost all the functions of the body, some of which have been already studied. Thus at this time the vasomotor center is excited, causing universal vascular constriction. There is often also secretion of saliva, inhibition or increase of intestinal movements, *constriction of the pupil*,[4] and so on.
>
> 3. At the end of the second minute after the stoppage of the aeration of the blood, the expiratory convulsions cease almost suddenly, and give way to slow deep inspirations. With each inspiratory spasm the animal stretches itself out, and opens its mouth widely as if gasping for breath. The whole stage is one of exhaustion; *the pupils dilate widely*,[4] and all reflexes are abolished. The pauses between the inspirations become longer and longer, until at the end of four or five minutes the animal takes its last breath.

Therefore, the implication that we were not aware that dilatation of the pupil occurs in a later stage of asphyxia is unworthy of further mention. Nor need any attention be paid to the term "original communication" applied to our note, for by this fact alone he shows that he had not read it even with

[1] SCIENCE, N. S., 1910, XXXI., 578.

[2] SCIENCE, N. S., 1910, XXXI., 395–396.

[3] "Elements of Human Physiology," 1907, 8th edition, pp. 404–405.

[4] Italics mine.